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INVESTICATION OF THE EFFECT OF WATER SATURATION ON THE VELOCITY OF ULTRA-SONICS IN CERTAIN ROCKS AT HIGH PRESSURES

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Wright-Patterson Air Force Base, Ohio

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Block	Italic	Transliteration	Block	Italic	Transliteration
А а	*А а*	A, a	Р р	*Р р*	R, r
Б б	*Б б*	B, b	С с	*С с*	S, s
В в	*В в*	V, v	Т т	*Т т*	T, t
Г г	*Г г*	G, g	У у	*У у*	U, u
Д д	*Д д*	D, d	Ф ф	*Ф ф*	F, f
Е е	*Е е*	Ye, ye; E, e*	Х х	*Х х*	Kh, kh
Ж ж	*Ж ж*	Zh, zh	Ц ц	*Ц ц*	Ts, ts
З з	*З з*	Z, z	Ч ч	*Ч ч*	Ch, ch
И и	*И и*	I, i	Ш ш	*Ш ш*	Sh, sh
Й й	*Й й*	Y, y	Щ щ	*Щ щ*	Shch, shch
К к	*К к*	K, k	Ъ ъ	*Ъ ъ*	"
Л л	*Л л*	L, l	Ы ы	*Ы ы*	Y, y
М м	*М м*	M, m	Ь ь	*Ь ь*	'
Н н	*Н н*	N, n	Э э	*Э э*	E, e
О о	*О о*	O, o	Ю ю	*Ю ю*	Yu, yu
П п	*П п*	P, p	Я я	*Я я*	Ya, ya

*ye initially, after vowels, and after ъ, ь; e elsewhere. When written as ё in Russian, transliterate as yё or ё. The use of diacritical marks is preferred, but such marks may be omitted when expediency dictates.

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GRAPHICS DISCLAIMER

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RUSSIAN AND ENGLISH TRIGONOMETRIC FUNCTIONS

Russian	English
sin	sin
cos	cos
tg	tan
ctg	cot
sec	sec
cosec	csc
sh	sinh
ch	cosh
th	tanh
cth	coth
sch	sech
csch	csch
arc sin	$\sin^{-1}$
arc cos	$\cos^{-1}$
arc tg	$\tan^{-1}$
arc ctg	$\cot^{-1}$
arc sec	$\sec^{-1}$
arc cosec	$\csc^{-1}$
arc sh	$\sinh^{-1}$
arc ch	$\cosh^{-1}$
arc th	$\tanh^{-1}$
arc cth	$\coth^{-1}$
arc sch	sech^{-1}
arc csch	csch^{-1}

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rot	curl
lg	log

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By: T. S. Lebedev and D. V. Korniyets

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Investigation of the Effect of Water Saturation on the Velocity of Ultrasonics in Certain Rocks at High Pressures

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(Institute of Geophysics, Ukrainian SSR Academy of Sciences, Kiev)

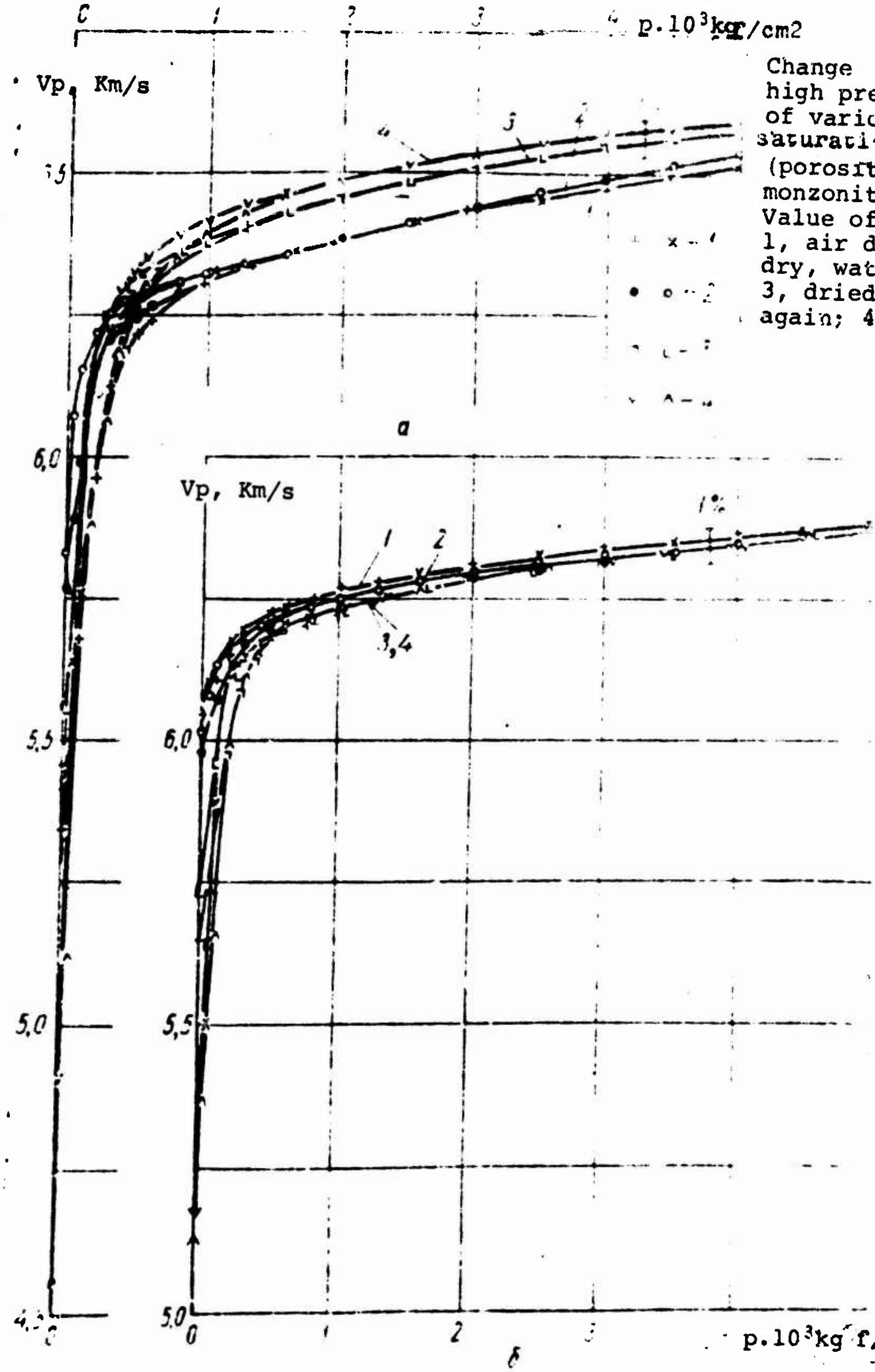
Studying the influence of water saturation in magmatic rock on changes in elastic properties under conditions of high thermodynamic parameters is quite timely, since it is connected with explaining the factors affecting changes in the speed of elastic waves in the plutonic zones of the earth's crust Only isolated works on this question are known.

We conducted investigations to clarify the features of the changes in the velocity of ultrasound (v_p) at atmosphere pressure and over the whole range of confined pressures (to $5 \cdot 10^3$ kgf/cm^2) in samples of several types of magmatic rock of the Ukrainian layer with the natural moisture content (air-dry), water saturated and dry*. For this two identical cylindrical samples were prepared from each of four ore specimens of diorite, granodiorite-sorbite, quartz monzonite and porphyritic granite. After measuring the initial speed (v_{po}) at natural moisture content the experimental samples underwent water saturation under vacuum conditions. Then the velocity (v_{p1}) was again determined in them, after which all samples (experimental-water saturated and air-dry control) were covered with a water

* T.S. Lebedyev, D.V. Korniyets, Geofiz. sb. AN USSR (Geophysical Collection, Ukrainian SSR Academy of Sciences), 1971, 38, pp. 3-11.

impermeable oil film and subjected to the first experimental cycle at confined pressure. Further, after removal of the protective covering the experimental samples were dried at 100° C and satyrated with water again. Each such process ended with a measurement of the speed (Vp2 and Vp3, respectively). Then these samples were again covered with protective film and subjected to a second trial under high P with simultaneous registration of the change in $v_p=f(p)$. Finally the experimental samples were dried again and for the last time subjected to test under high P. Aside from the data obtained in the above sequence, the total porosity and volume moisture content of the samples were determined.

Analysis of the experimental results allows one to establish that forced water saturation of air-dry magmatic rock samples with a porosity n<1% changes v_{p0} very little. In rocks with n=1.3-2.4% an increase in v_{p0} is observed, but only by 0.1-0.15 km/sec. The most considerable change in v_p (by 8-24%) is only characteristic of samples which were dried. However even after water saturation their speed (v_{p3}) still remained lower than the initial by 2-5%. Therefore water saturation does not fully compensate for the disturbance of acoustical contact between rock grains.



Change in velocity under high pressure in rock samples of various degrees of water saturation : a) granodiorite (porosity 2.4%); b) quartz monzonite (porosity 0.4%). Value of v_p in samples: 1, air dry (control); 2, air-dry, water saturated 3, dried and saturated again; 4, dry.

The results of experiments at high pressures (P), partially presented in the figure as graphs of $v_p=f(p)$, show that an intense increase in v_p in the rock samples studied occurs independent of their water saturation on increasing P from atmospheric to $0.6\text{-}1\cdot10^3$ kgf/cm^2. Then monotonic changes in rate are observed. Even in the initially air-dried and then water-saturated sample the value of v_p was 0.25-0.55 km/sec lower than that at $1\cdot10^3$ kgf/cm^2. The presence of liquid in the intergranular spaces of the samples enhances the disturbed acoustical contact and increases the initial speed which leads only to a less clearly expressed increase in v_p in the range up to $1\cdot10^3$ kgf/cm^2. At higher pressures a further elevation in v_p occurs in water saturated and dry samples with the same gradually decreasing gradient. Therefore the water saturation does not prevent the gradual compression of the rocks. The correlation of the v_p value in rock samples at high pressures also does not reveal any effect connected with moisture content, since the nearly linear portions of the graphs (respectively curve pairs 1,2 and 3,4) coincide or are located within the confidence limits of the values. Thus one may conclude that the degree of water saturation does not exert a significant effect on the rate of propagation of elastic waves in magmatic rocks of the deep layers of the earth's crust.